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Electric Railway Signalling, without the Use of Wires.

Abstract of a paper by Prof. William Robinson, read before the Society of Arts, Massachusetts Institute of Technology.

(CONCLUDED.)

PROLONGING THE DURATION OF BATTERIES.

Mr. Robinson made a communication also on prolonging the duration of batteries. In his system of signalling, the draft upon the battery is continuous, and its life would be very short under the usual arrangement. A single cell of Callaud battery attached to a section of rails a mile (more or less) in length, used continuously, will operate a signal for ten or twelve days; in this time the sulphate of copper is rapidly consumed, the current is gradually decreasing, and finally becomes so weak that it is necessary to set up the battery anew.

This being a very serious objection, he commenced a series of experiments, with the following results: He duplicated the battery, using two cells instead of one, but complete and independent, so arranged that only one is in circuit at a time, every passing train throwing one battery out and the other into circuit, automatically and at intervals, whose frequency varies according to the number of passing trains. The result is that they last from 140 to 160 days without renewal or the addition of any chemicals; the current is so uniform that no re-adjustment is necessary. Thus, duplicating the battery and using it intermittently, multiplies the duration seven-fold. The cause of this interesting fact is not determined; Professors Henry and Barker do not explain it; the general statement is, that a given quantity of zinc will produce a certain amount of electricty, and that it makes no difference in that amount whether you consume it continously or at intervals. Believing that the solution of the zinc is not the only element in the problem, he offers the following explanation:

When a battery current is passed through a jar of acidulated water, the water is decomposed and its elements collect upon the plates in the jar, the hydrogen upon the plate connected with the zinc of the battery, and the oxygen upon that connected with the copper element. If then the circuit from the battery be opened, and the wires from the jar connected, the galvanometer will detect in this circuit a current the reverse of that of the original battery current.

This so-called polarizing current tends to neutralize the direct current: supposing the last to be five and the polarizing current two, the effective battery current will be only three. If the circuit be kept closed for a considerable time, the polarizing current gradually becomes stronger, until it neutralizes the effect of the direct current. We have used the jar of acidulated water merely for illustration; we can remove this from the circuit and show that the polarizing current is continuously generated within the battery itself when the circuit is closed. Let the circuit be closed, and as the water is decomposed the hydrogen collects on the copper element of the battery, forming a thin film or envelope over the same. This hydrogen acts in two ways to deteriorate the battery; first, mechanically, in protecting the copper plate and preventing its collecting the electricity to pass it over the circuit; and second, chemically. Hydrogen is an electro-positive element—similar to zinc in this respect—and if two plates of zinc, for instance, or any two similar metals or elements be used in the battery, there will be no electrical action. When, therefore, the copper plate of the battery becomes highly coated with hydrogen, it is like having two plates of zinc in the battery—that is, two electro-positive elements, opposed to each other; the result is that the battery current is rapidly deteriorated, and ultimately destroyed by polarization.

The Callaud battery may be on continuously closed circuit for several days before sufficient hydrogen is collected on the upper plate to materially affect the action of the battery. If now we close circuit, say for one hour, we have, during this time, a strong current, and there is in such a short time but little hydrogen collected on the copper plate. If now we open the circuit, during the next hour the little hydrogen collected on the copper plate during the first hour will escape, leaving the copper plate clean or nearly so, so that when we close circuit during the third hour the current will be as strong as during the first. It will be seen that by using the batteries in this way they never become polarized, and the duration is limited only by the quantity of battery material originally put in.

On a wireless signal in West Somerville, Mass., the battery has been in operation already, without renewal, more than one hundred days, and the current today is as strong as it was three months ago. Furthermore, the signal operated by this battery has been running now above eleven weeks, since finished, including the worst and most stormy weather of the winter, but without a failure of any kind.

If a battery be left on open circuit too long it will become polarized, the sulphate of copper will rise and form a casting upon the zinc, virtually opposing copper to copper—similar elements. When this has occurred, to recover the battery close the circuit for a few hours until the sulphate of copper—the blue solution—has disappeared from the vicinity of the zinc, then brush the copper deposit from the zinc.

The above remarks on the *causes* of the phenomena described are designed mainly to be suggestive, and may be somewhat modified by further light on the subject.

Narrow-Gauge Railways.

Admitting the claims of the narrow-gauge in cheapness of construction and in economical operation, it is at the same time evident that in entering into active competition with railways constructed of the regular gauge they will encounter some very formidable obstacles. In the first place the 4 feet 8½ inch gauge system has been extended through nearly all the country, and the railways of that system posess the advantage of having occupied the ground first, and of being so located that they can transact business with distant parts of the country more conveniently and more expeditiously. Under the most favorable circumstances it would require many years to construct a narrow-gauge system which could be run independently of the established gauge, and consequently the business of the narrow-gauge roads must be of a local character, except where they occupy new ground, and must of necessity make connections with established lines. This involves a transfer of passengers at points of junction, and the breaking of bulk in the transportation of freight. In time this trouble might be overcome by extending the system, but that is a remote remedy. In cases like that of the Denver and Rio Grande these objections would have less force, because that road, when completed, will be of itself a trunk line and control transportation for a long distance in a comparatively new country; but applying the conditions to narrow-gauge lines projected and in process of construction in the states west of the Mississippi, it will be readily admitted that for a long time they must be unable to work successfully, except under harmonious arrangements, with the network of regular gauge roads. But these cheaper and more economical railways are admirably adapted to accommodate local traffic, which is not reached conveniently by the established roads. As branch lines to gather business which would not pay for the construction of the broader gauge roads, but would make very good returns on the smaller cost of the three feet tracks and lighter rolling stock, they would serve admirably as feeders, and also furnish much-needed facilities to districts of country within a few miles of trunk lines, but too far from the stations to share in the advantages of railway communication equally with the thrifty settlements on the direct lines. In this point of view, we hold it to be for the interest of the companies operating roads of the established gauge to encourage and promote the construction of these feeders in every way they can, consistently with the interests of their own lines. This may be done by establishing stations at convenient points of junction, or by giving liberal facilities at any stations already located, by running trains which may be intersected without difficulty, and, finally, by making equitable and even liberal adjustments of tariff on reciprocal business.

But the policy which dictates the construction of the branch line will be urged in support of the building of roads to run from point to point in direct competition, and the narrow-gauge projectors may claim that, in order to reap the full benefits of the system, they must build the entire distance,—as, for example, between New York and Philadelphia. But if this course is insisted upon, the narrow-gauge lines will meet with an unlooked-for trouble, perhaps. The older lines, having purchased land and erected buildings at a time when such property could be acquired at less than one-half its present value, would occupy a position which could not be secured by their competitors except by the expenditure of an amount of money which would neutralize much of the saving in construction of track through the open country. Instances there may be, doubtless, as in the case of the Boston, Revere Beach & Lynn Railway, where favorable approaches may be secured at a low cost, but these cases must be rare, and the position of Boston, in respect to this question of entrance, is just what is required to illustrate our point. Several lines are projected from densely populated districts within a radius of ten or fifteen miles of that city, and they are favorably considered because the Revere Beach road has been a decided success. But unless these lines form a junction with the Revere Beach line, and thus avail of its terminal facilities, they will inevitably run the risk of an expenditure for station accommodation, within the city limits, to an extent which will deprive them of a large part of the advantages claimed inl ower cost.

But to avoid this, and to incorporate the new gauge into the system already in operation, we would have the older lines propose to accommodate branches, and then to propose, if necessary, that the narrow-gauge shall be constructed over their road-beds with rails between the 4½ feet track and upon the same ties, or with one rail of the narrow gauge and one of the broad, forming the new track; and also propose that the cars should run tnto the same stations and enjoy the same privileges, all of which should be paid for at the rates based upon the estimated cost of the narrow-gauge lines, and a fair proportion of the cost of stations in the city and of the expense of their maintenance. In brief, we would offer to give the narrow-gauge road superior facilities at a fair interest on the cost of the proposed undertaking. The advantages of such an arrangement to the new roads will be obvious; they would avoid the necessity of raising a large amount of money for city accommodations, and track construction, and only be obliged to pay an equitable rate of interest on that amount, and they would at the same time be at liberty to charge such rates as they deemed advisable. To the older companies the arrangement offers the alternative of making the narrow-gauge lines contributors to the cost of their roads, or of seeing competing lines established where they can be avoided.

The subject could be pursued profitably, but we had only intended to write a suggestive chapter, and have already gone beyond our original designs. If there is anything in these points which can be made practicable to railway men, in meeting one of the questions of the day, we shall have accomplished our object in contributing to bring the rival gauges into more harmonious relations.—*Railway World.*

A Report upon "Sanitary Relations to Health Principles of Architecture."

BY CARL PFEIFFER, ARCHITECT, F. A. I. A., OF NEW YORK.

A paper read at a Meeting of the American Public Health Association.

Dr. Mapother has justly remarked that, after medicine "as professions most concerned in the preservation of public health rank those of the Architect and Engineer." This paper is designed to illustrate the relations of Architecture to the science of Hygiene; a very important relation, since the architect is required to furnish the dwelling in which we pass much of our lives, while the dwelling exercises a more decided influence upon our health than the clothes we wear. Every adult inhales some 360 cubic feet of air in the course of twenty-four hours, and this is but a tithe of the amount which he requires to regulate bodily temperature; but to insure to each individual the full needed amount, accessible to him every hour of the day, his dwelling must be properly constructed.

EQUABLE TEMPERATURE OF VITAL IMPORTANCE.

The feeding and regulation of temperature of the human body is a matter often overlooked, and yet of equal importance. For, so fixed and immutable is the temperature in a healthy body, that the blood of a negro in equatorial Africa, or of a Hindoo in the heats of Asia, is, by no perceptible fraction of a degree warmer than the blood of a healthy Esquimaux near the north pole. The atmosphere in which these different bodies live may differ as they do, by more than a hundred degrees; but if the clothing and the house do not neutralize this enormous difference, if the temperature of the body is allowed to sink or rise to any perceptible degree, sickness and ultimately death are the result. It is a wonderful hygienic instinct which leads the seal-hunter to build snow-huts, and the European in East India to erect houses with the thickest of walls. Hence, the architect must keep both objects in view if he would not build hospitals and tombs for his clients instead of comfortable and healthy dwelling.

Vast as are the technical requirements which his profession imposes upon him, apart from all sanitary considerations, the science of hygiene further demands from him, that he should study *first*, the climatological and meteorological phenomena of the place where he is to build; *second*, the geological condition of the ground upon which the building is to be erected, *third*, the material of which he is to construct the building; and on the basis of these studies, he must arrange the proposed house in such a manner that it may both feed the human body with air and preserve its normal temperature. How these studies have been neglected, the majority of our public halls, court-rooms, prisons, hospitals, asylums, churches, school-rooms, etc., are melancholy evidences, not to mention private dwellings, tenement houses, and hotels.

And here let me ask you, who have this matter more especially in charge, should not the law which protects men from adulterated food, and adulterated liquor, exercise its power also to protect him from adulterated air? It is quite true that people get to be fond of adulterated whiskey, coffee, bread and the like; so fond, indeed, that they seem to prefer them to the pure article. Thus, if you go into large workshops you will generally find the men bent on keeping fresh air out on coldish days, thinking that if they fill a work-room with the evaporations of their united bodies they will soon make it comfortable. Yet no reasoning is more fallacious than this. It is the fresh air, the cold air from the outside, which has the elements of heat in it, when warmed by a fire, whilst the evaporated air of their own bodies is pregnant with chills, however much warmed.

You will always find, therefore, in closed workshops of *such* a kind, that the workmen clamor for more fire. Why? Because what they conceive to be warming (the evaporation of the bodies of their fellow-workmen,) is nothing but deathly iciness. To rid men of the false notion that an adulterated atmosphere which seems warm is *not* warming, constitutes one of the most difficult problems which you, as well as we architects, have to contend with, since almost all classes of men labor under its delusion.

THE SCIENCE OF VENTILATION.

The special science which has for its object this mediating between the body in this the house, and the atmosphere outside of the house, is called the Science of Ventilation; Ventilation from *ventus*, *wind*, a moving of air. Hence, the problem of that science is to effect such a moving of the air as may be needed to feed and regulate the temperature of the human body within the house, by means of the house. There are two ways by which the air can thus be set and kept moving. 1st, mechanically, by means of fans, called the system of propulsion; 2d, by means of heated chimneys and flues, called the system of suction. In addition to these methods, much is done by what is called natural ventilation; but this is not to be depended upon at all stages of the weather, nor at all seasons of the year, its operation depending upon three forces, viz.: diffusion, winds, and the difference in weight of masses of air of unequal temperature. I may here add that cleanliness in a building is an indispensable requisite in the proper working of any system of ventilation.

Of the mechanical means of ventilation I shall not attempt to speak here for want of time, beyond saying that in all large buildings, nay, in all large cities, they are indispensable, however costly their arrangement.

Concerning the *second*—it is first to be observed that to some degree every house is of itself necessarily a ventilator; and thankful we ought to be that it is so. Streams of air pour continually from the outside through the walls into the inside, not to say through the ground on which the house stands. These streams may not be sensibly perceptible, as is the water that oozes through the walls and the ground; nevertheless, they are constantly present and operative. Aye, and so powerful are these currents that you can blow out a candle held against the wall close on the inside of a house from the outside. Every wall (particularly the mortar) is porous, and walls are more porous in proportion as they are less moist, for moisture clogs up the bricks, stone, and mortar, and thus obstructs ventilation. Moist walls, therefore, being almost air-tight are unhealthy in a double way; *firstly*, by the action of their moisture, which draws the heat from our bodies, making us shiver, and causing all sorts of rheumatic complaints, *secondly*, by obstructing the passage of the air. Hence, also, the great unhealthiness of new buildings, to which I desire to call your special attention. Doctor Von Pettenkofer estimates that a newly built house of fifteen rooms and cellar, contains in its materials some 3,300 cubic feet of water, which must be evaporated before the house is properly inhabitable. Please realize this, and say whether or not the law which considers it a duty to provide punishment for the adulteration of food, drinks, etc., ought not by some means to prevent people from occupying newly built houses, wherein it is impossible to breathe aught but adulterated air!

RELATION OF ARCHITECTURE TO HYGIENE.

One of the first principles of architecture in its relation to hygiene is that all the materials of a building should be dry and porous before it is inhabited, and should be subsequently so kept. The very furniture of a house can chill and produce rheumatic affections if it is damp and has been long in an unheated room, for in that case it acts as a power of suction upon our body, drawing out its vital heat. It strikes me as one of the barbarisms of vulgar belief that cold bedrooms are considered magazines of health; they are rather breeders of disease, unless they also have ventilation. People go to sleep in air-tight, cold rooms, in the belief that it is healthy, particularly if they have the bedroom well aired in the morning. Yet all the night long the air in the room stays unmoved and gets slowly poisoned, while the evaporation of the body settles upon the walls and makes them more and more air-tight. If any one fresh from the outer pure air enters such a room he is almost nauseated by the vitiated atmosphere; even as that open air recluse of Walden Pond, Henry Thoreau, used to hold his nose when passing dwelling-houses, the doors of which were opened for the first time in the morning. Cold rooms in winter time, let me add, are not only uncomfortable for the poor but are active agents of producing disease; and the phenomenon of epidemics in cold weather which has excited so much wonder—is a very natural consequence of neglected ventilation; and it is as one of the chief means of checking these winter diseases and epidemics, that Doctor Von Pettenkofer urges governments, above all things, to supply the poor with fuel in winter. For to have ventilation there must be difference between the air in the house and the outside air; just as to get ventilation by means of chimneys you must have fires in the chimneys. It is only when this difference exists, when there is a cold layer of air pressing the warmer air upward, that ventilation results. But in his cold room, the poor man has no ventilation and he is thus forced by the cold, not only to freeze, but also to breathe a vicious atmosphere.

An erroneous idea seems to prevail in regard to the healthfulness of our sleeping apartments; it is often asserted that they should be cold in order to be healthy; in alluding to this a medical journal states that "A moderate amount of heat is needed in a bedroom, but *that* moderate amount is needed in winter time. There is no advantage in going to bed in a cold room, nor in sleeping in a cold room, nor in getting up and dressing in a cold room. Persons may survive it, many have lost health by it. To have the chill taken off the air on going to bed and when dressing, is comfortable and healthful. A room under forty-five degrees is a cold room for a sleeping apartment, and sleeping in an indoors atmosphere lower than that is always hurtful, and always positively pernicious, for the simple reason that such a temperature causes the carbonic acid gas of a sleeping apartment to condense and settle in the lower part of the room, where it is breathed into the lungs with all its pernicious results. Sleeping in a room cooler than above named is especially dangerous to feeble, aged or invalid persons, as it tends to cause inflammation of the lungs. Persons may sleep out of doors with impunity when the thermometer is many degrees lower, because the out-door air is pure, is full of life, full of oxygen, without any admixture of in-door poison, and hence gives a vigor of circulation which keeps the whole body warmed to its natural point, resisting cold and all diseased conditions."

Cold, free, fresh air outside the house is indeed quite a different thing from cold, putrid air inside the house; a fact which, in examining the causes of diseases, is too often overlooked. Chimneys and flues that have no fire in them, far from ventilating, may rather become the means of hoarding and sweeping down disease into the room.

TWO FACTORS NEEDED TO MOVE AIR.

That two factors are needed for the proper moving of air should never be forgotten. A means of escape of foul air, and an inlet of fresh, pure air; and that the means of making these two factors operate upon each other is heat.

Thus, as Docter Von Pettenkofer wisely remarks, do the walls speak to us of a life of their own; and Shakespeare was not over extravagant, after all, when he represented the wall as speaking and disclosing its aperture, through which Pyramus and Thisbe (the human body inside the wall, and the air outside), spoke to each other, kissed each other, and committed the like absurdities.

I have dwelt perhaps to too great an extent on the ventilation which a house may be made to furnish of itself, by means of its material, if properly dried after its erection, and kept dry afterward. This, however, is only a small item, and the chief ventilation of a house must always be procured by artificial means; that is to say, by chimneys in one form or another, and these means must be increased in proportion to the exegincies of the building.

Thus it is estimated that there is required for every person each hour:

In Hospitals, for ordinary patients, from 2,000 to 2,800 cubic feet of fresh air.

In Hospitals for wounded patients, 4,300 cubic feet of fresh air.

In Hospitals, for epidemic patients, 5,600 cubic feet of fresh air.

In Prisons, 2.100 cubic feet of fresh air.

In Workshops, from 2,000 to 3,500 cubic feet of fresh air.

In Barracks, from 1,000 to 1,650 cubic feet of fresh air.

In Theatres, from 1,400 to 2,400 cubic feet of fresh air.

In Meeting-houses, from 1,000 to 2,000 cubic feet of fresh air.

In Schools for Children, from 400 to 500 cubic feet of fresh air.

In Schools for adults, from, 800 to 1,000 cubic feet of fresh air.

Large as these figures appear, they have been determined in two ways—by mathematical calculation, and by innumerable experiments, all of which have corrobo-

rated the independent mathematical calculation. Ranke, in his "Grundzuge der Physiologie" (Elements of Physiology), fixes the average quanty at sixty cubic metres, or 2,118 cubic feet per hour for each individual, as the necessary minimum amount. In cities it has to be considered, moreover, that each gas-burner needs the introduction of from four to five thousand cubic feet of fresh air every hour, facts, all of which it is necessary that the architects should keep in mind in order to secure a sufficiency of artificial means of ventilation whereby to furnish this amount of air, and furnish it in a proper degree of purity and warmth to make it conformable to the requirements of the human body. Of course, architecture is mainly an art, I am quite well aware, and I am, perhaps, more sensitive than many of my profession upon this point. I desire that our houses, as well as all our buildings, should express *externally* and *internally*, beauty,—that harmony, symmetry, proper proportion of sizes, colorings, and the like, which fill the eye with that supreme satisfaction, whereby men are lifted, as by the utterances of religion, to a higher and nobler life.

[TO BE CONTINUED.]

STREET PAVEMENTS.

(CONCLUDED.)

(From the St. Louis Republican.)

In Washington, where there is a section of it known as the Neuchatel pavement, the city engineer says that its slippery surface causes it to be shunned by ordinary travel. In Paris, where more of this kind of pavement is used than anywhere else, we are told they are giving it up and returning to the old-fashioned stones. (See Van Nostrand's Eclectic, vol, 6, p. 112.) It is possible that this objection may be removed by some improved method of laying, but until it is done, pavements of this material cannot be recommended for general use.

Of the bituminous concretes, or artificial asphalts, there are many kinds of various degrees of merit, but the purpose of all of them is by an artificial union of substances to form the natural asphalt rock. In all of them the principal ingredient is gravel, which is mixed with vegetable tar, sometimes with coal tar, and sometimes with natural pitch from the island of Trinidad.

The mixture is laid down upon a bed of concrete, or sometimes upon the surface of an old pavement—when it is called "poultice"—in a heated state, and then consolidated by rolling precisely as is done with the asphalt rock. The surface formed is very much the same as the natural rock, except that it is not so slippery.

The great question concerning pavements of this kind is as to their durability. If the cement used be vegetable tar, as the Fisk concrete, the life of the pavement is of necessity short.

For the volatile parts of the tar pass off, the mixture dries up, and soon nothing is left but an incoherent mass of sand and gravel. If ordinary coal tar be used the same thing is true, except that the process of drying up is somewhat slower.

It is claimed, however, that by proper distillation the volatile elements of the coal tar may be all driven off at first, leaving behind a tar that is stable under ordinary atmospheric influences.

But the Trinidad asphalt, being a natural pitch and already subjected to atmospheric influences, is probably better for this purpose than any artificial product.

The durability of the pavement will also depend upon the quality of gravel used.

A silicious gravel will last longer than one of limestone. But even with the best materials very much will depend upon the proportions in which they are mixed Too much bitumen will give a concrete that will soften in the sun; too little will give a mixture that lacks coherence. The conditions of success in this matter are indeed so numerous, and the whole business so new—the oldest concrete pavement being but eight years old—that we are not surprised that most of the experiments have so far been failures. That any artificial compound will ever be made to equal in durability the natural asphalt rock is more than doubtful, but it is possible that something may be found which shall be sufficiently durable and so much less slippery as to be on the whole better than the natural rock, and perhaps better than anything else. Meantime, whilst giving pavements of this sort a fair trial, it will be wise to hasten very slowly in adopting them on a very large scale.

THE STREETS OF ST. LOUIS.

We come now to consider very briefly the condition of our streets here in St. Louis as seen in the light of the foregoing discussion.

The bad condition of our streets is due to several causes, amongst which we may name:

1. Their faulty original construction. We do not use our materials to the best advantage. The plan adopted for all but our few block pavements is the original plan of Macadam without modification. We throw down a bed of broken stone immediately upon the clay, which is neither ditched or rolled as it should be, and then let the ordinary travel pack it as best it can.

The result is that the road is not consolidated for months, during which time the loose stones get rounded off and ruts are worn into the surface of the road which is short lived and never good. The very same materials put down in the form of a Telford road, with a sub pavement of 6 to 8 inches deep and a top coating of 6 inches of broken stone thoroughly rolled, would, with about the same or possibly a little greater cost, give us a road smooth from the first, and far cheaper to maintain than those we have now.

2. The absence of any proper system of street maintenance. The macadam once thrown down, is left to take care of itself until it wears out. The ruts are not raked in, the holes are not filled up, the mud is not kept off. When the street becomes impassible, new material is put on to be neglected and ground up like the first. All this is wrong. There should be a regular force of men in constant employ like the section men on a railroad, whose business it should be to take care that the ruts and holes were not formed, and that mud was not allowed to collect—to see, in a word, that the streets never got bad.

This is the system generally adopted in Europe, and in addition to being the best system, it is also the cheapest; as could be easily be shown by much testimony if it were needed. But it is only an exemplification of the maxim that "a stitch in time saves nine," and hardly needs proving even if we had the time.

3. The narrowness of our wagon tires. This is an evil which I have barely time to mention, but it is a very serious one. As a rule, we carry our loads on narrower wheels than anywhere else in the world, though why it is I do not know. The English cab has the tire almost as wide as our four horse wagon, and some of our wagons carry as much weight per wheel as is allowed for a freight-car. The consequence is that the material of our roads are crushed, and the street destroyed long before there is any need of it. If we could enforce it, of which I am by no means certain, we ought to have a law taxing all freight wagons in the inverse ratio of the widths of their tires, making the rate nominal for every wide tires and prohibitory for very narrow ones.

4. The street car tracks work great injury to our streets, The rails interfere very seriously with the drainage of the street and pavement the water passing off as it would otherwise do. This softens the surface and hastens its destruction. Again, the rails direct the traffic in fixed lines which very soon wears the streets into ruts. The part between the rails is in particular subjected to so great a wear that it soon becomes a mere gutter. As we cannot take the track up, the remedy is to put down a stronger pavement than would otherwise be needed. As a rule such streets should be paved with stone blocks, and the space between the rails ought to be so paved in all cases.

But with all the improvement that can be made by a better system of construction and maintenance we shall never have really good streets in St. Louis until we use better material in the first place. The remedies I have suggested would do much to alleviate our condition, but they would not effect a radical cure.

The limestone macadam with which 95 per cent. of our streets is now paved, grinds up rapidly in spite of all that can be done, and streets made of it are of necessity dusty and muddy and short lived. To get better results we must use more durable materials. Those which I would suggest are granite blocks, limestone blocks and broken granite. The streets should be divided into three classes, according to their traffic. Those of the first class, with the heaviest traffic, should be paved with granite blocks; those of the second class, with limestone blocks; those of the third class, having the lightest traffic, should be paved with broken granite. This latter pavement should be made in the form of a Telford road using as a foundation a rough pavement six or eight inches deep, of our common limestone. Or in some cases we might use our present macadam roads as a foundation taking care to have them first properly cleaned and surfaced. On this foundation should be put about six inches of broken granite or porphyry. It should be put on in two or three courses each carefully rolled, and the top course should be finished off with a binding of sand sprinkled and rolled in. I give these specifications because they are vital and must be followed under penalty of another failure like that with porphyry before. But by observing them we shall get a pavement smooth, hard and durable, and which, though not entirely free from dust, will probably be on the whole more satisfactory than any other we can get.

In order to show more accurately the limits of each class, as well as the comparative cost of the new system, I have constructed a table, which will be found below, of the annual cost—including payments for interest, for ordinary repairs and for final renewals—of various pavements under different conditions of traffic. In this table, besides the cost of the new pavements, I give also the cost of our present pavements of limestone macadam under two different sets of circumstances; the first being that in which we build a new pavement with fresh capital on which interest must be paid; and the second, that of an old pavement already down and concerning which the only question is whether we shall or shall not maintain it. The latter is for us the most common and the most important.

I may remark that the figures given are based in the main upon prices and experience here, but that in estimating the life of the new pavements I have been obliged to take experience gained elsewhere, under circumstances somewhat different.

Subsequent experience may therefore change them somewhat but I am satisfied that it will leave the relative cost of the different pavements unchanged.

TABLE of annual cost of different pavements per square of 100 square feet:

	12 ins. thick.	6 ins. thick	4 ins. thick	3 ins. thick	2 ins. thick	1 in. thick
	Life 1 year.	Life 2 years.	Life 3 years.	Life 4 years.	Life 6 years.	Life 12 years.
New macadam...	$6.50	$4.10	$3.30	$2.90	$2.50	$2.10
Old macadam....	6.25	3.95	3.05	2.65	2.25	1.85
	4 ins. thick	2 ins. thick	1½ ins. thick	1 ins. thick	2-3 ins. thick	1-3 in. thick
Telford granite...	$7.62	$4.72	$3.75	$3.27	$2.80	$2.30
	8 yrs.	16 yrs.	24 yrs.	32 yrs.	48 yrs.	.....
Limestone block.	$5.51	$3.73	$3.31	$3.08	$2.89	.....
	20 yrs.	40 yrs.	60 yrs.	.....	.....	.....
Granite block....	$4.31	$3.61	$3.45	.....	.....	.....
	5 yrs.	.....	.....	.....	.....	.....
Nicolson.....	$5.50	.....	.....	.....	.....	.....

From an inspection of this table we see that the limits of our three classes are as follows:

The first class calling for granite block pavement embraces all streets on which six inches or more of limestone macadam are worn out in a year, which is done by a traffic of about 1,500 teams or 2,250 tons per day.

The second class, calling for limestone block pavements, embraces all streets on which the annual wear of limestone macadam is three inches or over but less than six inches.

The third class, calling for the Telford granite pavement includes all streets on which the annual wear of broken limestone is less than three inches. Exactly what street would be included in each of these three classes would have to be determined by careful observations to be made hereafter. The third class however, would doubtless embrace the greater distance.

You will notice further that only the two latter classes call for any increased expenditure over that of our present system. In the third class the increase is 55 cents per square per annum over that required by an old macadam pavement, and 30 cents per square over that of a new one, the difference becoming less as the traffic diminishes. By putting down a somewhat lighter pavement, which for many streets would answer every purpose, this difference might be easily be turned in favor of the new system. In the second class the greatest increase is 43 cents per square in case of an old pavement, and 18 cents per square in case of a new one. In the first class, including all streets of heavy traffic, the difference is in favor of the improved pavement, amounting in some cases to nearly $2 per square, showing that our present system is only maintained at a large loss of money. And in the second and third classes, if we add to the direct money cost, given in our table, the indirect money cost of our present pavements, including the diminished efficiency of horses, the injury to vehicle, the extra cost of watering and the damage done by mud and dust to mind, body, and estate, the balance will incline very decidedly even here in favor of the better pavements.

The great if not the only objection to the proposed system is that it would involve a large immediate outlay more perhaps than the city can easily raise and more than we like to entrust to our city government to spend. We are afraid of rings and jobs. But surely there is wisdom enough left us to take this matter out of politics and demand of those in charge simply honesty and professional skill.

If we do this we can get what we demand; and in good hands the outlay need not be excessive. A wise administration would move steadily but slowly, following closely at every step the dictates of experience and taking good care to make every possible use of the old materials now on our streets.

In this way the cost would be spread over several years but at the end we should reach a condition worthy of the place amongst cities to which we aspire but which we are very far yet from having attained.

Contractors' Intelligence.

The bids for the construction of two new bridges—one being a 108 feet span and the other 148 feet—for Mercer County, Pa., were opened by the County Commissioners at Mercer, Pa., on the 17th ult. Bids were received from the Penn Bridge and Machine Works, New Brighton, Pa.; Canton Bridge Co., Canton, Ohio; King Iron Bridge Co., Cleveland, O.; Columbia Bridge Co., Dayton, O.; Keystone Bridge Co., Pittsburg, Pa.; Iron City Bridge Co., Pittsburg, Pa.; Buckeye Bridge Co., Cleveland, O.; Smith Bridge Co., Toledo, O.; Cincinnati Bridge Co., Cincinnati, O., and the Massillon Iron Bridge Co., of Massillon, O. The contracts were awarded on the 26th ult., the Penn Bridge and Machine Works receiving that for the 148 feet span on their bid of $19.75 per lineal foot for an arch bridge with wooden beams. The 108 feet span, consisting of two 14½ feet roadways, and two 7½ feet footways with three girders, was awarded to the Massillon Iron Bridge Company at the price of $36.50 per lineal foot, for their patent Howe truss arch bridge, with iron floor beams. The bridge is to replace one recently condemned, over Shenango River at Greenville, Pa.

ENGINEERING NEWS.

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THE EFFECT OF TEMPERATURE ON IRON TRUSSES.

The change of length in iron trusses caused by change of temperature is allowed for as is well-known, by the placing of rollers under one end of each span. Such a contrivance cannot be used with arches, and they consequently rise and fall at the crown as the temperature varies. The amount of play to be allowed is easily obtained by multiplying together the coefficient of expansion of the metal, the length of the span and the number of degrees from the greatest heat to the greatest cold.

It is found, however, that the allowance previously calculated is more than is needed, and the question arises which one of the above factors is in error. It is stated that the structure lags behind the air in temperature; when a thermometer in the open air is rising, one protected from the air and in contact with the iron, will have a lower reading, and *vice versa*. During a long continued elevation or depression of temperature, we should expect that the two thermometers would give indications more nearly alike. The lower chord of a bridge which is covered, or floored over on the upper chord, will be protected from the extremes of heat and cold, and the change of length will then be small. The *difference* in the amount of expansion of the two chords would have the effect of changing the camber, or causing the truss to rise and fall without alteration in mean length. The often observed fact that a bridge, even when at a considerable height above the surface of the water, will so protect the river beneath as to hinder and sometimes prevent the formation of ice in winter, shows plainly that the covering ameliorates the temperature which would otherwise exist below.

Some few types of truss are not internally strained by a change of temperature; but in others a change of shape from this cause initiates tensions and compressions in the different pieces by which their lengths are modified. The resultant movement at one end may therefore be made up of a variety of very small components which it would be difficult to trace out, but data from practical examples, for given types of truss, would furnish a coefficient of expansion for use.

There is one other direction in which a reason might be sought for a less change of length in a bridge truss than is expected. The coffiecient of expansion is not an absolutely fixed quantity, but increases with the temperature. In solids, the increase between 32° and 212° F. is stated to be hardly appreciable, but for high temperatures the increase becomes a considerable quantity. This increase in the coffiecients of expansion of bodies by rise in temperature is probably due to the distance between the particles being augmented with the heat, and their mutual cohesion being thus more readily overcome. The force exerted by an expanding or contracting solid may be measured by the power required to produce an equal change of length by compression or by tension. When a bar of iron of one inch in cross-section has its temperature changed 12° F., its expansion or contraction exerts a strain equal to about one ton, that is, it will require a force of one ton to keep the bar at the original length. If then the several pieces of a frame are under tensile or compressive stresses of some three or four tons on the square inch of section, and are thereby elongated or shortened,—since the particles are separated to greater distances in the one case or forced more closely together in the other—will not the coefficient of expansion be less or greater than the one for the normal state of the metal under no stress, and correspond with that one which in the scale of temperature would be correct were the bar already heated or cooled to the same linear dimensions?

If this were a fact, we should expect that an iron arch would exhibit less sensibility to a given change of temperature with a heavy load than with a light one, or than the expected amount for a rib of the same span under no initial compression. The deflecting of the crown is easily measured. On the other hand the vertex of the curve of a suspension bridge cable ought to have a greater alteration of level for the same change of temperature.

THIS is the season of the year, when if at all, both field and office work of Engineering and Surveying is at its best, The railway and other projects of improvement, which during the winter months have been discussed and matured, are now to be commenced, and surveying parties are busy in preliminary or final surveys preparatory to works of construction. In the cities this is the busy season of the real estate dealers, builders and surveyors, and the platting of new subdivisions and giving corners and grades of building lots keep the latter busily occupied well into the "heated term" at tolerably remunerative rates. But in this Centennial year we do not hear of many railroad surveying expeditions being fitted out. We do not suppose there will be any important sales unaffected if all the lot peddlers in the country should spend the whole summer in Philadelphia, and the surveyor who has only his profession to depend upon for subsistance will do well to waste no money in seeking business in Chicago, at least. The "oldest surveyor" reports this year to be the dullest for business ever known in Cook County, and from all appearances we think the worst is not yet come. There is very little demand for the surveys of building lots, and in sub-divisions the work is mostly in settling up estates, or getting out undivided interests for parties who wish to get some money on their hitherto unproductive real estate. There are no large suburban sub-divisions being offered for survey, and there are no surveyors here who would care to make them on the terms that now generally prevail, The city surveyors who have been able to keep an office open thus far, have still farther reduced expenses, and we caution any of the ambitious young men who expect to graduate from the several schools of Engineering in the country, in a few days, against "going west." Those who have homes to go to had better go there and stay until better times come; those who *must* get something to do or starve had better accept the first honest employment that offers, and hold on to it until something better presents itself; if they never are called upon to shoulder a transit, or drag a chain, at all, the chances are in their favor that they will do far better.

Engineers' Club of St. Louis.

The regular meeting was held on May 10th at the Society's rooms.

There were some fine photographs of the great works at Essen in Rhenish Prussia—Krupp's establishment, and also of the guns sent by him to the exhibition at Philadelphia, exhibited to the Club by Prof. Wm. B. Potter, and great interest was taken in examining them.

Some Indicator Diagrams taken from the Corliss Engine at the St. Louis Cotton Mill were shown by Mr. Smith, who gave an account of the changes made in the adjustments of the valve gear which were fully illustrated by the diagram.

The Jetties at the Mouth of the Mississippi River.

BY D. W. BOWMAN, C. E., SOUTH PASS JETTY WORKS.

(Written for Engineering News.)

In July, 1874, a Board of Engineers, consisting of "three from the Army, one from the Coast Survey and three from civil life," was appointed by the President under the provisions of an Act of Congress, approved June 23d, 1874.

The object of this board as stated in the act, was to "make a survey of the mouth of the Mississippi River, with a view to determine the best method of obtaining and maintaining a depth of water sufficient for the purposes of commerce, either by a canal from said river to the waters of the Gulf, or by deepening one or more of the natural outlets of said river." They were required to send in estimates of each of these plans, and to state which they considered preferable, with the reasons therefor.

In consideration of the importance of the subject, the board decided to examine the most noted cases of the river mouth improvements in Europe, and accordingly visited the Rhone, the Vistula and the Danube, and as "bearing on a canal and a harbor, the North Sea and Suez Canal."

In its report the board says:—"The result of these examinations abroad has been to largely strengthen their estimate of the value of jetties at the mouth of the Mississippi River, of the fascine-dikes used in Holland by Calend in the improvement of the Maas mouth of the Rhine." After giving a careful statement of the difficulties to be surmounted both in constructing a canal and in the improvement of one of the natural outlets of the river, together with the comparative cost of the different plans, the board in its recommendation says: "There is no question that the improvement of the South Pass would be best;" and finally, "it therefore recommends that the South Pass of the Mississippi River be improved by the plan already given." (Viz: fascine jetties.)

The board estimated the first cost of construction of the proposed improvement at $5,342,110, and the annual cost of repairs, maintenance and extension at $130,000, which capitalized at 5 per cent represents $2,600,000, making the total cost of the jetties at $7,942,000.

In accordance with these recommendations, by an act of Congress approved March 3d, 1875, James B. Eads was authorized to "create and maintain a wide and deep channel between the South Pass of the Mississippi River and the Gulf of Mexico, by means of jetties and such auxiliary works as may be necessary." The conditions imposed were, that the work should be substantially commenced within eight months from the date of the approved act, that twenty feet depth should be obtained through the Pass within thirty months from its approval and two feet additional depth each succeeding year until twenty-six feet of water shall have been secured. The act contemplated a final depth of thirty feet, for securing which depth and constructing the permanent works necessary for its maintenance, the sum of $5,250,000 was to be paid, and $100,000 per year for twenty years thereafter during which the depth of thirty feet should be maintained,—a sum somewhat less than the estimate of the board. No payments were to be made until twenty feet of water were obtained when the sum of $500,000 was to be due, and each additional two feet up to thirty was to secure an approximately proportional payments. As a guaranty for the performance of the work one million dollars were to be retained in the Treasury of the United States, one half for ten and one half for twenty years, with interest payable semi-annually,—subject to the action of Congress to release it at any time.

At the time of the appointment of the Board of Engineers, two different plans were being urged; that of the jetties, of which Captain Eads was the author, and that of a canal running from Ft. St. Phillip, easterly to the Gulf, which was strongly urged by Maj. Howell, Gen. Humphreys and other United States Engineers, The act of Congress authorizing Capt. Eads to undertake the work, was passed only after a long and determined struggle, in which the merits of the jetty plan conquered. Ever since the work began it has received from the supporters of the canal project continued opposition, not only in open discussion of the principle upon which the plan is based, but in misrepresentation and ridicule. New Orleans itself, more vitally interested than any other section, has looked on unfriendly and indifferent.

In this contract Capt. Eads and his associates assumed all the risk, the Government assumed none, and a depth of water was required, deeper than was ever obtained, at a large annual expense, through the other Passes which have a natural depth of water on the bar twice as great as at South Pass, before one dollar was to be paid,

On the 13th of June, three months after the authority was conferred upon Capt. Eads, the work was begun. Few, who have never seen the mouth of the Mississippi River, can form any adequate idea of the appearance of this singular region. The great "Father of Waters," bringing down in its rushing course the spoils of half a continent gathered from the Alleghanies to the Rocky Mountains by its tens of thousands of veinlets, which, by the silent yet unceasing action of Nature's universal law are leveling down the traces of her former convulsive throbs, now as in the long ages past, is conquering inch by inch the domain of the sea, and pushing out farther and farther the outskirts of the continent. It is a perpetual conflict between the sea and the river, and the history of this struggle and of the river's conquest, all the way from Cairo to the sea, is written in an universal language whose characters shall tell as clear a story to the nation's ages hence as to those of to-day.

Here upon this battle ground, at the very front where the struggle still continues;—where day by day the tides of the Gulf, in a vain endeavor to regain the field, ebbing and flowing over the narrow banks which confine the river, build up by insensible degrees the breast work of its foe;—where the river hour by hour unceasing carries out before it its burden, and, as if conscious that its work is done, piles it up before the sea which in vain endeavors to beat it back; here was to be the scene of this enterprise so prophetic of renewed prosperity for the west and south-west; here like magic was to spring up this village, whose future no one can foresee. On all sides nothing but nature in her utmost *abandon*, with not a trace of civilization save a light house on the land, and out upon the Gulf occasionally the white sails of commerce, flecking the horizon like the fleecy summer's cloud.

There was no romance about the enterprise! It required continued patience, to work in the wild cane and mud, day after day, laying the foundation for the future work; beginning with their primal wants—wharves, boarding houses for the men. walks built from place to place above the reach of the tides, shops for artizans, ways for the mattress construction, depots for coal, lumber and other stores: and step by step constructing in this wilderness the plant necessary for the prosecution of the great work. A hundred miles above, at the "Crescent City," was the source of all their supplies. Not an article of all this multiplicity of needs could be obtained nearer. With no regular communication with New Orleans, except such as they themselves could furnish, the preparatory work was necessarily carried on under great disadvantages. But, notwithstanding this, at an early day the work proper was in progress, slowly at first, but with increased rapidity as the enterprise became more firmly established, and the nature of the work better understood.

The South Pass of the Mississippi River is about 12 miles in length from the Head of Passes to the outer slope of the bar. Its course is a gentle curve to the east nearly in a prolongation of the main river, lying between South West Pass on the right and Pass a' l'Outre on the left. At its mouth its course is nearly south-east. At the Head of Passes, the quantity of water flowing into it is about 8 per cent or one-twelfth of the main river. About five miles down the Pass, 25 per cent of this is taken out by Grand Bayou which branches to the right and leads to the Gulf nearly parallel with the Pass. The width of the Pass is very uniform, averaging below Grand Bayou about 800 feet, and with the exception of a small bar in the river just above its entrance, it has a channel in many places 40 to 50, and nowhere less than 30 feet deep, until near the lands end on the east bank, at the mouth, where it begins to shoal and the bar commences.

According to the official survey, made in May, 1875, preceding the opening of the work, the distance from lands end on East bank to 30 feet of water outside the bar, was abont 12,500 feet. The 18 feet horizontal line was nearly 9,500 feet, the 15 feet line 6,250 feet, the 12 feet line 5,200 feet and the 9 feet line 2,900 feet in length. That is, if horizontal planes had cut the bar at these respective depths, the length of the sections would have been the above distances. For the latter distance the mean low water depth averaged about 7½ feet.

It was through this bar of fine sand that a channel was to be obtained. As the bar is formed at a point where the river, beginning to spread out, loses its velocity and with it the power to uphold its sediment, it is evident that if by any means the velocity of the water can be maintained it will continue to carry the sediment, and if its velocity be increased it will scour out and take up more. The jetties accomplish this. They are simply artificial river banks, beginning where the natural ones end and extending across the bar into deep water. The water of the river, confined by these within narrow limits, does precisely what it has done for ages, in the Pass above; it forms a uniform, deep channel by washing out this bar and carrying the material into the deep waters of the Gulf beyond.

The lines of the jetties are 1000 feet apart. The length of the East jetty from the lands end to the deep water where the jetty heads will be constructed, is about 12,500 feet. This extends out in nearly a straight line for 800 feet and then curves to the west with a radius of 16,000 feet, in order to strike more favorably the prevailing littoral current from the East, which has been found to exist. For most of its length this jetty is constructed on a lateral shoal where depths averaged not over 6 or 7 feet. At the other end it stops in 30 feet of water.

The west jetty, on account of the farther extension of the bank on that side, begins 4,000 feet further down than the east one, and extends paralled to it out to the same point. It is connected to the shore at its upper end, by a cross dyke 600 feet long. At its beginning it was constructed in much deeper water than was the east jetty, it being in 15 feet of water, in what was the deepest channel of the bar at that point. This depth gradually shoaled to the crest of the bar where it was from 6 to 8 feet.

The first steps in the construction of the jetties consisted in driving a row of piles, 10 to 20 feet apart, to mark out the line of each jetty. These serve to guide in the construction of the work, and to secure the more important "mattress" work until it has become firmly fixed in place. At the beginning of the work the old method was adopted of binding the willows into "fascines" or bundles, and then connecting them together by ropes and ties, as has for ages been practised in Holland for such purposes. This was a slow and expensive method and it proved to be wholly inadequate to the magnitude of the undertaking. The inventive genius of Capt. Eads and Col. Andrews suggested the method employed at present of making the willows into "mattresses" which has been both economical and rapid. For the construction of the "mattresses" parallel timbers are laid sloping into and perpendicular to the river. Across these at intervals of 5 feet are laid strips of plank, 3 inches by six inches, spliced together until they are 100 feet in length. At short distances hickory pins, 1 inch in diameter, are driven vertically into holes bored in these, and securely fastened. Among these pins willows are placed carefully at the bottom until a layer is formed across the strips, and afterwards without regularity until 2½ feet in thickness are obtained, when another layer crosswise of the first is placed at the top. Pieces of plank with holes corresponding to the pins which rise through the willows are put across at right angles to the bottom strips, the willows are pressed down, the pins are wedged in the holes, and with a few iron bolts and secure nailing the "mattress" is complete. It is launched from the ways by a steamer, towed to position alongside the piling, and sunk to the bottom with stone. The "mattresses" are usually 100 feet long, 2½ feet thick, and from 20 to 50 feet in width according to the position for which they are intended, the bottom tier being the widest, the successive courses narrowing to the top. For most of the length of the jetties, 4 courses have raised them up to high water mark and control the current. The top of the jetties will be ultimately paved with stone, and at the outer ends heavy jetty heads will be built sufficiently massive to resist the most violent action of the waves of the Gulf.

It may seem strange that so slight a material as this of which the jetties are composed should be able to control this rapid current and to withstand the severe storms which disturb the Gulf. But the mattresses are no sooner sunk to the bottom than the sediment of the water settles in and around them, and in a short time they become an integral part of the bottom itself, as immovable as granite. During the most severe storm of the season—the "equinoctial"—not even the outer ends of the jetties, where the waves come rolling in from hundreds of miles across the Gulf, was a mattress disturbed. As each succeeding report declared that the jetties were intact, it was generally remarked that they were constructed so as to last for ages, if they could pass uninjured through such a storm.

The principal source from which the willows have been obtained, is the "*Jump*," about 25 miles above Port Eads, on the right bank of the river. In 1840 a small canal at this point afforded to fishermen a short route to the shallow bays skirting the river. A high flood broke through here and made for the river another outlet to the Gulf. The deposit made by the water flowing through this, has formed a perfect archipelago, among whose low islands, narrow bayous wind their sluggish way. On these thousands of acres thus formed, the willows, which grow so plentifully all along the course of the river except for a few miles at its mouth, sprang up and formed dense thickets, the home of wild fowl and mosquitoes. Not an inch of all this territory existed in 1840; now from some of this land a growth of willows as large as a man's body has been cut, and the simple Arcadian peasants, the descendants of those exiles who long ago sought a home here, till the land in rice, which grows to perfection upon this rich deposit Not only here but from almost every available space below New Orleans the willows have been cut. The smaller limbs and branches only are used, nothing larger than 3 inches in diameter being allowed in the mattresses.

Besides the construction of the jetties, the improvements comprise two other distinct but auxiliary works; the closure of Grand Bayou and the construction of a dyke at the head of the Pass. A shoal of fluctuating depth exists in the river at the Head of Passes, upon which this dyke is built. The object of this is to create a deeper channel over this shoal, and also to deflect more water into South Pass. Both these works are under construction and will be completed at an early date. The latter is already constructed to mean low water for nearly 3000 feet. The condition of the jetties at this date (May 26th) is as follows: for a distance of about 11500 feet from lands end, on East Bank, the mattresses of both jetties are built up to average flood tide and confine nearly all the water. For about 500 feet further the jetties are partially constructed, but do not reach to within several feet of the surface, and the current flows out laterally over them. This represents a total length of nearly 20,000 feet, or about 4 miles, exclusive of work at Grand Bayou and head of Pass. Eleven months only have passed since the first blow was struck.

The action of the jetties upon the bar has already been sufficient to judge of their final effect, and to enable those who have staked their professional reputation upon their success, to vindicate the soundness of their conclusions. Careful soundings made on the 25th of March, 1876, and compared with the official survey made before the commencement of the work, shows that 1.815,000 cubic yards of the bar had then been removed from between the jetties. The distance from the 18 feet channel in the Pass to the 18 feet of water outside was about 9500 feet when the work began. Supposing this material to have been scoured out regularly across the channel for a width of 900 feet, the average deepening would be 5.7 for the whole 9500 feet. If the scour had been confined to a narrow channel it would represent an excavation through the bar 9,500 feet long, 22 feet in depth *below the surface of the bar*, 200 feet wide at the bottom and 270 feet on top. The soundings at date reveal the fact that there is a channel nowhere less than 22 feet in depth to within 2,000 feet of the deep water of the Gulf. On this remaining distance the least channel depth is about 17 feet,* where was the original crest of the bar with only 9 feet of water upon it. The bar is being continually scoured away and successive soundings reveal continued improvements in the channel. Not the least among the favorable results, is the fact that, in the deep water in advance of the jetties, instead of any indication of a re-formation of the bar, as was predicted by the opponents of the jetty system, would occur, the soundings to-day show that by some cause or other, the depth of water there has been increased;—probably by the action of the littoral current, which, following the shore, strikes the East jetty and rushes past the outer end with increased velocity.

Against powerful opposition, the jetties have been gradually working their way into the confidence of those interested in securing an open channel to the sea. Bitter opponents still exist, who, through self interest or pride of reputation, will try to turn success into failure. But while friends grow stronger and opponents more bitter, silently the great river, guided by the skillful hand of science, is sweeping away the barriers which shut out the world from the great heart of the continent.

* On the 25th inst. the steamer New Orleans, drawing 17 feet 3 inches aft, passed over bar at head of pass and through the jetties to within a short distance of the Gulf, where she grounded. The tide had fallen 11 inches when she entered ths jetties. She passed out without difficulty two hours before high tide on the morning of the 26th.

Correspondence.

EDITOR ENGINEERING NEWS,—In answer to C. M. Wilcox's problem submitted in your issue of May 27th, the following solution I trust will be found correct:—The north line of A's land, from which he sold a tract to B, was found by actual measurement to be 38.22 chs. which is exactly 152.88 rods, instead of 160 rods as it was supposed to be. Consequently it fell short exactly 7.12 rods. It is evident that the width of the tract must be increased above 16 rods enough to make up for what it fell short in length. 16 acres contains exactly 2560 square rods. Dividing the area by the exact length 152.88 rods we get for the exact width $16\frac{1424}{1911}$ rods, or 16 rds. 12 ft., $3\frac{220}{637}$ ins.

W. H. MYERS.

CHICAGO, May 30.

EDITOR NEWS,—I submit the following as a solution to the problem propounded by C. M. Wilcox, in your last number, as to what should be the width of the land sold to B. The boundary along Jones' line is definite—it is from A's N. E. corner, west to Jones' line, both ends of line are fixed, and cannot be changed though A may still be owner of land beyond Jones' line. The length of the line south from that point having no limit but the length given, that length is the limit, consequently B has not a title to the number of acres stated, and can only make A foot up in difference, not in land, but in damages fixed by court. This is our opinion, but the decisions of the courts of Ohio would be a much better guide than the opinion of all the surveyors out of that state.

M. H. MESSER, Surveyor.

ONARGA, Ill., May 29.

EDITOR NEWS,—In answer to Mr. Wilcox's question in your issue of the 27th inst., would state, that said 16 acre piece, having been sold by metes and bounds, has to be surveyed according to said description no matter whether it contains 16 acres exactly, or more or less. If the length of the north line from N E corner of A's land to Jones' east line is only 38.22 chs. instead of 40 chs., the east and west lines will still be only 4.00 chs. long; the north line of said land having been described by corners to be found, and in my estimation it does not matter how long said line is, the distance of the east and west lines is given distinctly and cannot be changed without violating the description of the deed. In this case the *amount of acres* does not govern the survey but the *description*. The width of a 16 acre piece of which the north and south line or length is 38.22 chs., would be 4.18⅓ chs.

GERMAN SURVEYOR.

WATERLOO, May 29.

PROPOSALS FOR CONTRACTS.

BRIDGE WORK.—Bids will be received at the office of the Commissioners of Hamilton Co., O., in Cincinnati, until Saturday, July 1st at 12 M., for masonry, excavation and superstructure for a bridge across Symmes Creek, on the road from Symmes to the Sixteen-mile Stand, Symmes township. Specifications can be seen at this office. Jos. B. Humphreys, Auditor,

BRICKS.—Bids will be received at the office of the Superintendent of the U. S. Custom House and Postoffice, St Louis Mo., until 12 M. June 14th for 1,500,000 hard burned bricks, for the E. S. Custom House and Postoffice at St. Louis, in accordance with specifications. Specifications, conditions, form of proposal, and any additional information may be had on application to Thos. Walsh, Superintendent.

BRIDGE.—Bids will be received at the office of the Commissioners of Hamilton Co., O., in Cincinnati, until July 1st at 12 M. for masonry of the abutments of a bridge across Millcreek, on the road from Hartwell to Lockland, in Sycamore township. Specifications can be seen at this office. Also, for an iron superstructure at the same place, clear span 80 ft.; clear roadway, 18 ft. Bidders will furnish their own plans and specifications therefor. A full and complete strain sheet to accompany each plan. Said bridge must be of sufficient strength to sustain 100 pounds per square foot of floor surface beside its own weight; factor of safety 4 15,000 tension, 12,500 compresson. Payments will be made in Hamilton Co. bonds, bearing interest at 7 per cent, By order of Commissioners. Joseph B Humphreys, Auditor.

CHURCH—Bids are solicted until June 6th for the erection of a frame church, 36x40 feet, at Dunlap, Ill. Plans and specifications can be seen at W. A. Bervey's, Dunlap. N. Dunlap, Chairman of Building Committee.

COURT HOUSE AND JAIL.—Proposals will be received by the Board of Co. Commissioners, at the office of the County Clerk until Thursday, June 15th, 1 P. M., for the building of a court house and jail, in Ford Co., Kansas. Said court house to be built of brick, 19 inch walls, 36 feet square and 24 feet high. Each bid must be accompanied with security, by bond of $2,900, conditioned for compliance with bid, if accepted. Plans and specfications can be seen at this office. Address, W. F. Sweeney, Clerk, Dodge City, Kan.

COUNTY PRISON EXTENSION—Proposals will be received by the Commissioners of Schuykill County, at their office, in the county court house, Pottsville, Pa., until 4 P. M., June 28th, for the roofing, plumbing and gas fitting, plastering, painting and glazing required for the extension of the Schuykill County Prison. Each of said proposals to be indorsed separately as above enumerated. Plans and specifications of the work may be seen at the Commissioners' office until June 24th. Morgan W. Fehr, Louis Blass, Patrick Collins, Commissioners. E. A. Schartel, Clerk.

COUNTY BUILDING—Proposals will be received up to noon of Friday, June 9th, for the erection and completion of an additional story to the county's fire proof office building, plans and specifications of which may be seen at the Auditor's office, Marion, Linn County, Iowa. Daniel Travis, James Yuill, Committee.

FURNITURE—Bids will be received at the office of the Clerk of the Board of Education of Cleveland, Ohio, up to 12 M., June 12th, for furnishing the necessary desks and seats for the Case Avenue school building. Proposals will be received for desks and seats known as the "Combination Desk and Seat" and for the "Desk and Chair" as follows: For about 450 Grammar grade; about 400 for the Intermediate grade; and about 300 for the Primary grade, samples to be placed in the Board of Education rooms. Each proposal must state separately the price for which each desk and seat will be constructed, and the cost of placing each desk and seat in proper position in said school building. F. M. Sanderson, Thos. A. Stow, F. Mulhauser, Committee on Buildings.

GAS LAMP POSTS AND LANTERNS—Proposals will be received by the Committee on Gas, at 3 P. M., June 12th, at the city hall, Vincennes, Ind., subject to ratification of Council, for not less than 55 nor more than 80 gas lamp posts and lanterns separately or jointly. A description of said articles, and weight of the posts will be required. The same to be delivered at any of the railroad depots in Vincennes, Ind., free of charges, within 15 days from date of contract. Envelopes containing proposals to be endorsed "Proposals for gas lamp posts and lanterns" and addressed to the undersigned. Geo. Harris, Chairman Committee on Gas.

HOSPITAL BUILDING—Bids will be received at the office of the Consulting Architect, Nath. J. Bradlee, 18 Pemberton square, Boston, until June 14th, at noon, for completely finishing ready for occupancy all the buildings now in process of erection for the State Hospital for the Insane at Danvers, Mass., also for the erection and completion of barn or stable, fences, &c. and building or repairing the station, farm house and other buildings. The proposals may be offered singly or jointly for the following works. mason work, carpenter work, plumbing, plastering, gas works, gas fixtures and painting. The plans and specifications may be seen at the office on the grounds. Saml. Cobb, C. C. Esty, Edwin Walden, Commissioners.

INSANE ASYLUM—Bids will be received by the Trustees of the State Charitable Institutions at the Insane Asylum near Osawattomie, Kansas, until Friday, June 20th, 1876, at one o'rlock P. M., for the erection of additions to the present Asylum, according to plans and specifications for the same, which may be seen at the Asylum, and also at the office of Haskell & Wood, Architects, Lawrence, Kansas. Each bid will be accompanied by a guarantee (blank forms of which may be had of Haskell & Wood, Architects), in the sum of one thousand dollars, signed by not less than two responsible parties, conditioned that the bidder will, if award is made to him, enter into contract for the work, and furnish satisfactory bonds for its faithful performance. Bids may be addressed to the undersigned, Insean Asylum, Osawattomie, Kansas, or handed to the Secretary on the day of opening. All bidders are requested to be present at the Asylum on the day of opening (June 20th). By order of the Trustees. W. B. Slosson, Secretary.

MASON WORK.—Bids will be received at the office of the Clerk of the Board of Education of Cleveland, Ohio. until 12 M., Monday June 26th for the mason work on the Mayflower School addition. Plans and specifications may be seen and blank proposals obtained at the Clerk's office on and after June 12th. The bid for labor and materials must each be separately stated with the price thereof. No proposal will be entertained unless made on the blanks furnished by the Board. F. M. Sanderson, Chairman Building Com.

PUMP AND ENGINE—Proposals will be received by the Board of Trustees of the town of Lake View, Ill., until 12 M., Monday, June 12th for furnishing the said town an additional pump for the water works and a single cylinder horizontal engine to drive the pump, capable of supplying six gallons per revolution. said pump and engine to be set up ready for use in the water works building, at the foot of Sulzer Street, in said town, by the party furnishing the same. Full specifications for the work can be seen at the office of the Town Clerk. Proposals to be sealed and addressed to Seth F. Hanchett, Supervisor of town of Lake View, and indorsed "Proposals for pump and engine." Seth F. Hanchett, Supervisor.

RAILROAD WORK—Proposals will be received at the Manager's office of the Troy & Greenfield Railroad and Hoosac Tunnel at Greenfield, Mass., until Thursday, June 8th at 12 M., for grading, rip rap, track laying and ballasting that portion of the Troy & Greenfield Railroad, between Shelburne Falls and Charlemont. Specifications and quantities can be had at the Chief Engineer's office in Greenfield. J. Prescott, Manager.

ROOF AND CORNICE WORK—Proposals, addressed to the undersigned, will be received at the office of the Washington Aqueduct in Washington,, D. C. until 12 M., June 12, for constructing an iron truss roof and galvanized iron cornice on the Gate House at Great Falls. Plans and specifications can be seen at this office, and all necessary information can be obtained from O. E. Babcock, Col. of Engnrs., U. S. A., Chief Engr. Washington Aqueduct.

SEWER—Proposals will be received at the office of the Board of Public Works of Cleveland, O., until 12 M. June 15th for constructing a sewer in Danton Av., between Hopkins and Gest Sts., in accordance with plans and specifications on file at this office. John E. Bell, President.

STONE CULVERT—Bids will be received at the office of the City Engineer until Friday, June 9th at 12 M. for furnishing material and building a stone culvert on Forbes Street near Boquet Street. Plans and specifications can be seen at the City Engineer's office. Proposals to be addressed to Robert McClelland Engineer of Forbes St.

STREET IMPROVEMENTS—Bids will be received by the City Council of Lima, Ohio, at the City Clerk's office, until Monday, June 12, 1876, at noon, for the stoning and graveling of McDonald street, from Wayne street south to Market street. Bids to state the price per cubic yard. 1. Five inches of broken stone and five inches of gravel. 2. Eight inches of broken stone and two inches of gravel. T. C. Sherman, City Clerk.

SCHOOL HOUSE—Proposals for building a school house at Whitehouse, Lucas Co., O., will be received by the clerk of the board up to 12 M., June 12th. Drawings and specifications for same are on file at the office of said clerk in Whitehouse and at the office of Gibbs & Moser, architects, Toledo, O. By order of the Board of Education. F. A. Butler, Chairman. J. L. Pray Clerk.

STATE BUILDING—Proposals for furnishing all materials and the erection of a fish state hatching house, and also a tenement house, to be erected at the Nine Springs, in Fitchburg three miles southwest of West Madison depot, according to plans and specifications thereof, will be received by the Fish Commissioners of Wisconsin, at the law office of Welch & Botkin, 23 Pinckney Street, city of Madison, where plans and specifications can be seen, 12 M., Monday, June 26th. Separate proposals will be received for the two buildings to be erected. Fish Commissioners.

SCHOOL HOUSE—Proposals will be received at the office of the Clerk of the Board of Education of Norwalk township, Huron Co., O., until 12 M., June 24th for building a brick school house on the lot situated in sub-district No. 2 of said township, according to the plans and specifications on file in said office. The bid for each kind of material called for by the specifications must be stated separately, and the price of each must be separately stated. By order of the Board of Education. H. L. Kennan, Clerk, No. 4, St. Charles Block, Norwalk, O.

ST. ANTHONY'S FALLS IMPROVEMENT—Bids in duplicate will be received by the undersigned, at the U. S. Engineer's office, in St. Paul, Minn., until 12 o'clock, noon, June 29, 1876, for the following work at the Falls of St. Anthony, Minneapolis, Minn. 1. Furnishing the materials and constructing two dams on limestone ledge. 2. Filling a portion of the old tunnel and other passages under the lime rock above the dyke. For all information apply to F. U. Farquhar, Major of Engineers.

STREET IMPROVEMENT—Bids will be received at the office of the Board of Improvements of Cleveland, O., until 12 M. June 23d, to furnish and lay stone flagging for sidewalks for the ensuing year. The city is to be divided into three or more districts and proposals will be received for each district separately. Sealed proposals will also be received at the above mentioned time and place for furnishing any laying crosswalk stone at street crossings for the ensuing year. Also, proposals will be received separately for furnishing and laying. And, proposals for cross-walks will be received for the East and West Side separately. Specifications and blank proposals can be obtained at the office of the City Civil Engineer. By order of the Board. M. G. Watterson, Clerk.

SCHOOL HOUSE—Proposals will be received at the Township Clerk's office of Franklin Township, Summit Co., O., until 12 M., June 14th, for building a school house on the lot located in Sub-district No. 5 of said township. according to plans and specifications on file with the Township Clerk. The bids for each kind of material called for in the specifications must be separately stated. By order of the Township School Board. Hiram Dissinger, Clerk.

SCHOOL HOUSE—Proposals will be received by the School Board of the Independent school district of Pella, Ia., until noon June 17th, for the erection of a school house, plans and specifications of which can be seen at the office of C. Rhynsburger, Pella, Iowa. Bids may be made as follows: 1, excavation, draining and grading; 2, stone and brick work of entire foundation; 3, all brick and stone work above foundation; 5, carpenter work on entire building; 5, painting and glazing, also all tin or iron work in and about building including gutters; 6, entire building, covering all above named separate items. Address D. S. Huber or C. Rhynsburger, Pella, Iowa.

STEAM HEATING APPARATUS AND BOILER—Proposals will be received by the Regents of the University of Wisconsin for putting a steam apparatus to heat about 750,000 cubic feet, in their new Science Hall building. Also, separate proposals for furnishing a low pressure steam boiler of 8 feet diameter and 26 feet length. The plans and specifications for both classes of work can be seen in Milwaukee, at the office of H. C. Kock, architect, where any information in relation thereto can be had. Proposals will be received by John S. Dean, Secretary, at Madison: Wis., before June 18th, will be considered, and if satisfactory to the Regents, the work will be contracted for. N. B. Van Slyke, Chairman Building Committee.

STREET IMPROVEMENT—Proposals will be received at the office of the City Engineer of St. Joseph, Mo., until 12 M., June 6th for grading of Olive Street from 8th to 6th. 11th Street from Mesanie to Sylvanie Streets. Jule Street from 3d to 5th Streets, and 4th from Francis to Faraon Streets. All bids for grading must state the price per cubic yard. Also, bids will be received at the same time and place for the macadamizing, guttering and curbing of 9th Street from Frederick Ave. to Mitchell Ave.; Jule Street from 3d to 5th Streets, and 4th from Francis to Faraon. Bids must state the price per lineal foot for curbing, per square for guttering, per square for macadamizing. By order of the city council. T. M. Long, City Engineer.

STATE EDUCATIONAL INSTITUTION.—Proposals for furnishing material and the erection of the main building of the Institution for the Education of the Blind, in the city of Janesville, Wisconsin, according to the plans and specifications thereof, will be received by the undersigned, at his office, No. 6 East Milwaukee Street, Janesville, Wis., until 12 o'clock noon, June 15th 1876. The plans and specifications may be examined at the office of A. Anderson, architect, (under whose supervision the work will be done), at No. 37 West Milwaukee Street, Janesville, from and after June 1st 1876. Proposals may be made separately for mason work, including the cast iron work connected therewith; and for carpenter work, including galvanized and wrought iron work, tin work, painting and glazing. Proposals will also be received for doing the entire work. For further particulars address or call upon the undersigned. J. B. Whiting, Secretary of the Board of Trustees of the Wisconsin Institution for the Education of the Blind.

STATE HOUSE IMPROVEMENT—Proposals will be received by the Comptroller of the Treasury of the state of Ohio. for the proposed improvements of the ceiling and skylights of the Senate Chamber and the House of Representativer at Columbus, until 10 A. M., Friday, June 16th. Bids will be received separately for the following classes of work: 1st, all the wrought and cast iron work for the ceiling lights; 2d, all the sky lights complete; 3d, all the painting and the glazing of the ceiling lights; 4th. all the plastering and plaster enrichments. And also for the whole complete in one bid. Plans, specifications and instructions for the same are now file at the office of the Architect, 117 South High Street, Columbus, Ohio, for the inspection of bidders. Each bid must be accompanied by a guarantee of $1,000, so conditioned that if the bid is accepted the bidder will enter into a contract with a bond of double the amount of his bid. The work must be perfected and completed by October 15th, under a heavy penalty for failure to do so. All bids must be sealed and directed to the Comptroller of the Treasury, and indorsed for what class of work they are intended. W. T. Wilson, Comptroller Treasury, T. R. Tinsley, Architect.

TOWN BUILDING—Proposals will be received by the Clerk of the incorporated village of Harrison, Hamilton Co., O, until 12 M., Thursday, June 22d, for the erection of a new town hall building. It will be understood by each bidder that a reserve of 15 per cent will be held until the building is completed and accepted by the Superintending Architect and Building Committee. Work to commence immediately after the letting. For plans and specifications call on the undersigned, Town Clerk, Harrison, Ohio, or on Parsons & Co., architects, Indianapolis, Indiana. By order of the Council. J. F. McManaman, Town Clerk.

WATER WORKS—Bids for making a filtering basin, by dredging or otherwise, and for building a gate chamber, will be received at the office of the Water Commissioners, in Cole's Block, Newton, Mass, until noon of Wednesday, June 7. Proposals will also be received at the same time and place for laying about 600 feet of 24-inch cast iron pipe, below the bed of Cearles River. Plans and specifications may be seen at the Commissioner's office, and at the office of Shedd & Sawyer, 38 Barristers' Hall, Boston. R. M. Pulsifer, Francis J. Parker, R. R. Bishop, Commissioners.

WROUGHT AND CAST IRON WORK—Proposals will be received at the office of the Supervising Architect at the Treasury Department, Washington, D. C, until 12 M. May 30th, for furnishing, delivering, fitting, and putting in place the wrought and cast iron work, comprising columns, pilasters, etc., of second and third stories, and as exhibited on the drawings, described in the specifications, and called for in the schedule. Copies of the drawings, specifications, schedule, and form of proposal, and any additional information, may be had on application in the superintendent of the building, or at this office. Wm. A. Potter, Supervising Architect.

WATER WORKS—Proposals will be received by the mayor of Marshalltown, Iowa, at his office in said city up to 2 P. M., Saturday, June 10th, for building and furnishing the following work, all to be first-class: 2 steam pumping engines; 2 boilers for same; house for pumps and boilers, with well, filter, and stack; about five miles of water pipe of the size of 4, 6, 8, 10 and 12 inch; special castings for the same; laying said pipe; trenching and backfilling for same; 15 valves for above size pipe; 50 hydrants. All to be built according to plans and specifications, which may be seen at the office of T. A. Boutelle, engineer of said city, on and after June 5th. Bids will be received for the entire work complete or any part or parts as specified. The right is expressly reserved to increase of diminish the quantity of pipe and special castings, the number of valves or hydrants or to reject any or all bids. O. B. Barrows, Mayor.

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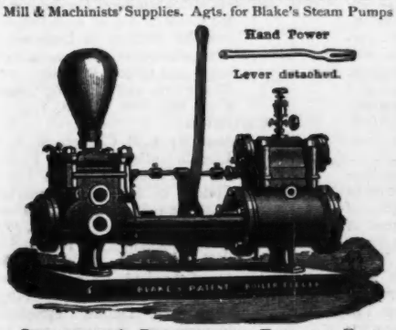

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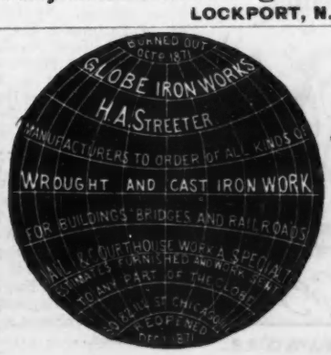

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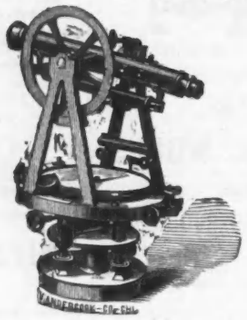

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